

# **Perchlorate in the Environment: Modeling Considerations**

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# Modeling Objective:

Predict the long-term  
effects of perchlorate on  
terrestrial and aquatic wildlife



# Model Suite

- Small mammal PBTK model
- Terrestrial plant model
- Fish PBTK model
- Aquatic vascular plant model\*
- Stream periphyton model\*
- Avian PBTK model\*

\*under construction



# **Modeling Team**

- **Ken Dixon**
- **Srivatsa Acharya**
- **Eric Albers**
- **Sam Anderson**
- **Randy Apodaca**
- **Pinar Dogru**
- **Janae Oldham**
- **Lori Sheeler**



# Model Characteristics

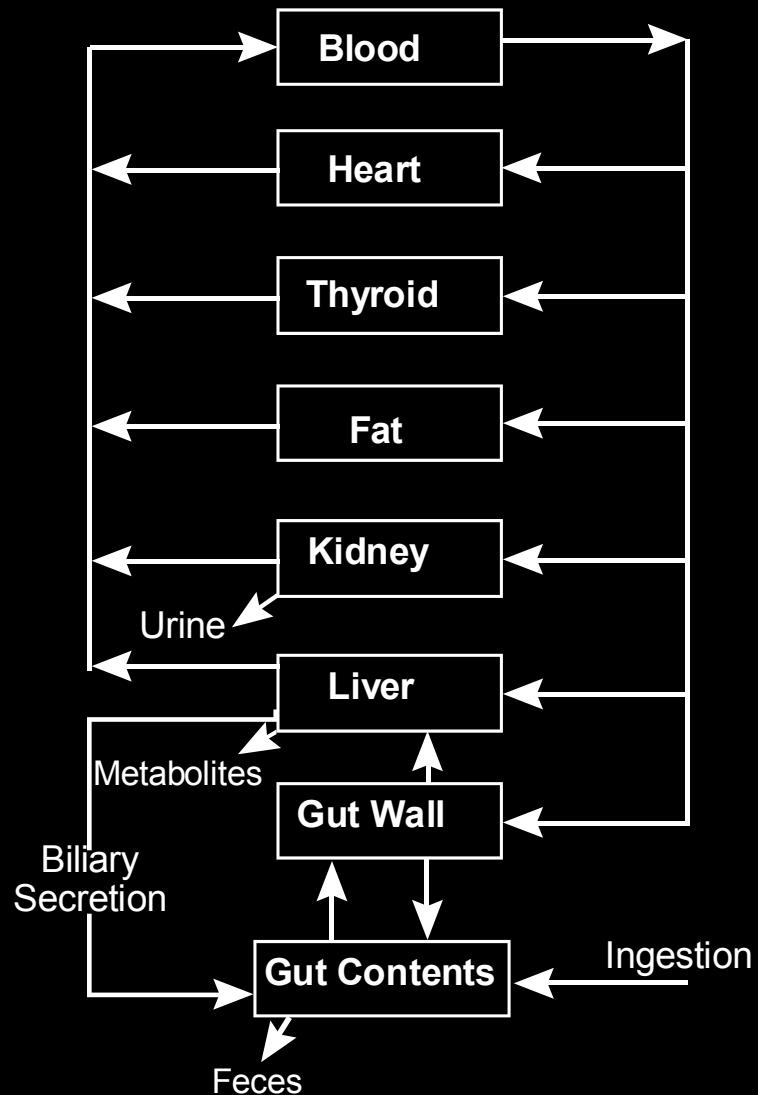
- Physiologically-based Toxicokinetics
- Species-specific exposure pathways
- Individual (agent ) based
- Stochastic (allows Monte Carlo simulations)
- Animal movement allows exposure to spatially heterogeneous perchlorate concentrations



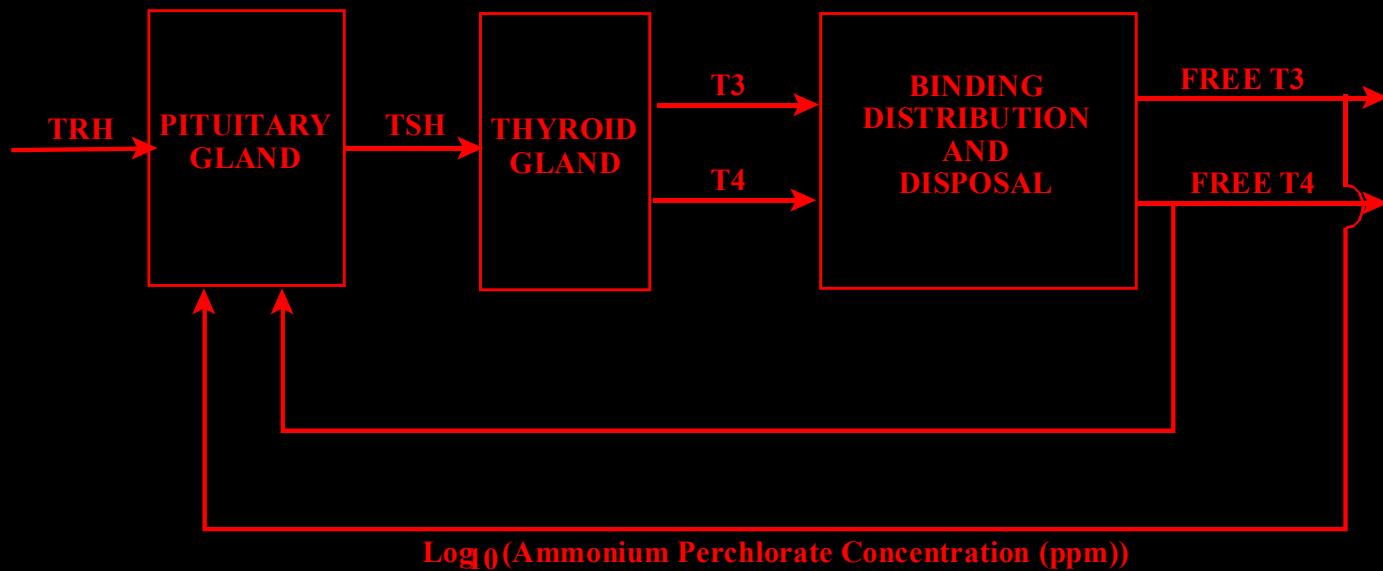
# **Small Mammal Model**



# Flow Diagram



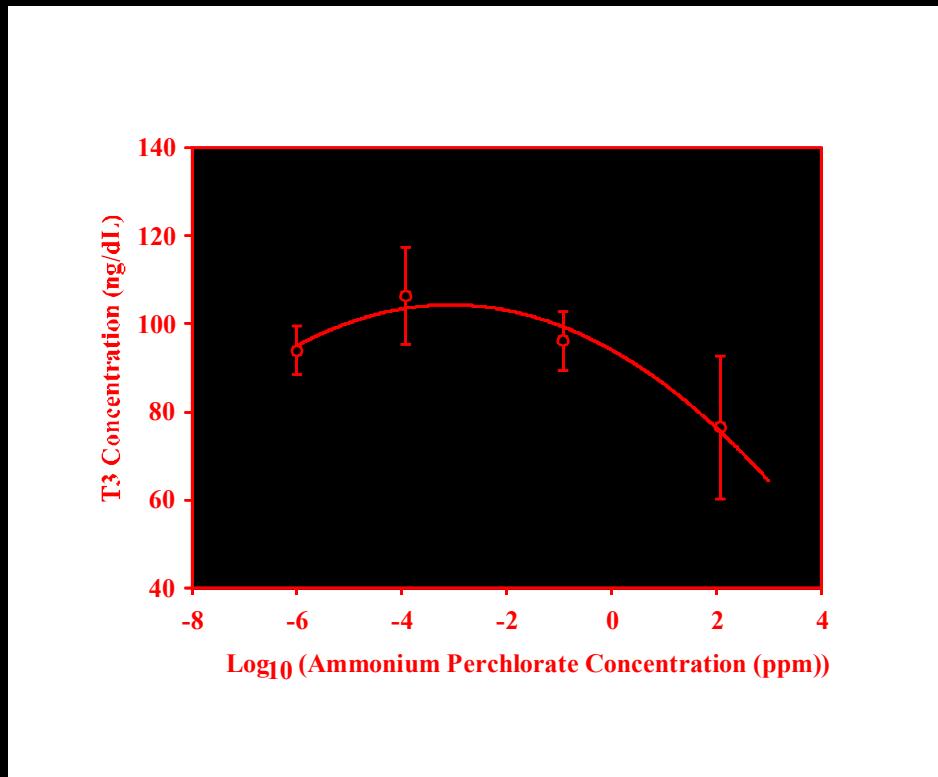
# Feedback Between Thyroid Hormones and Pituitary Gland



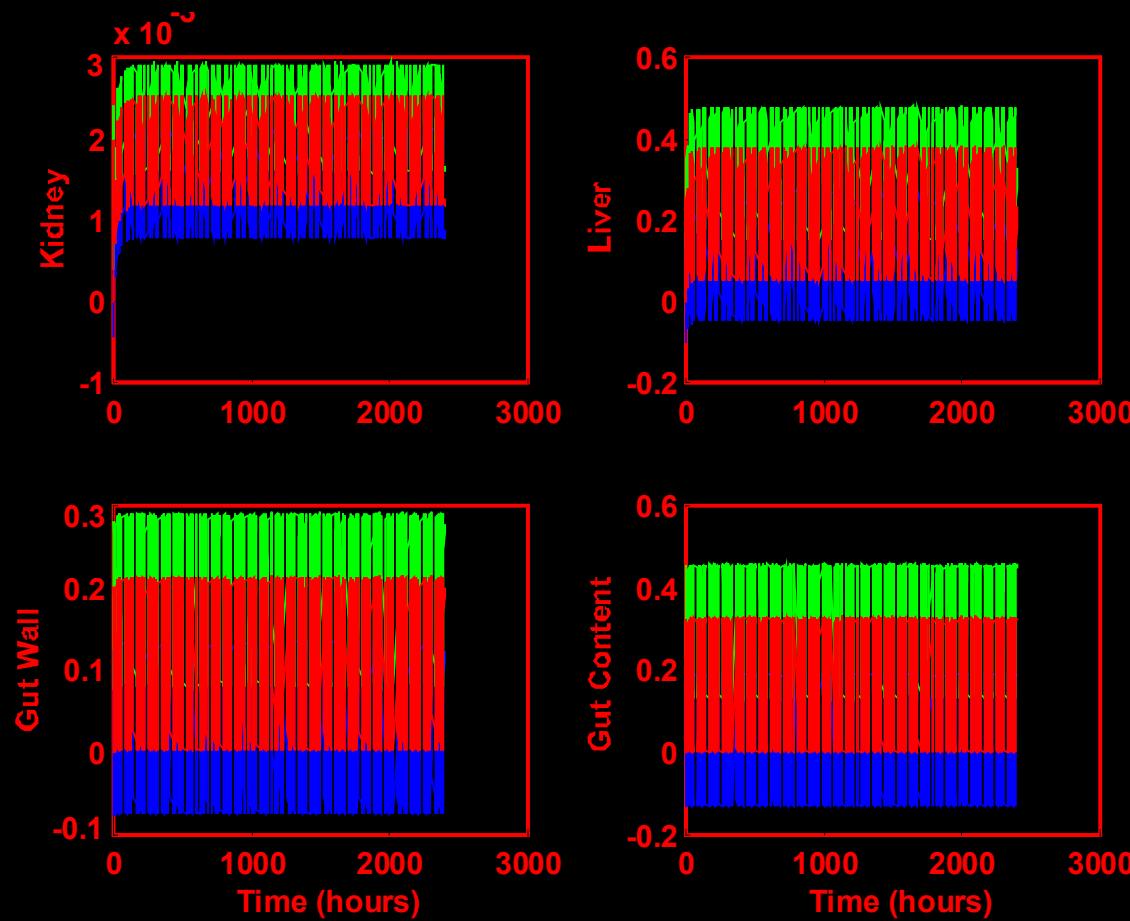
$\log_{10}(\text{Ammonium Perchlorate Concentration (ppm)})$



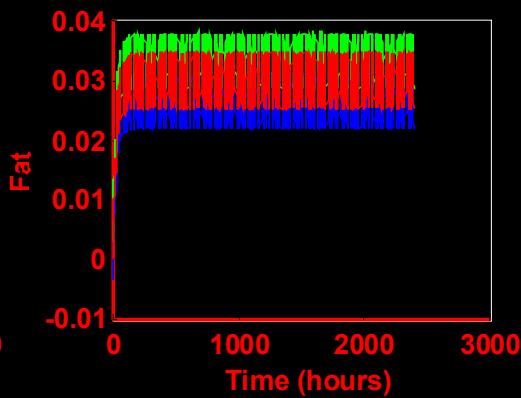
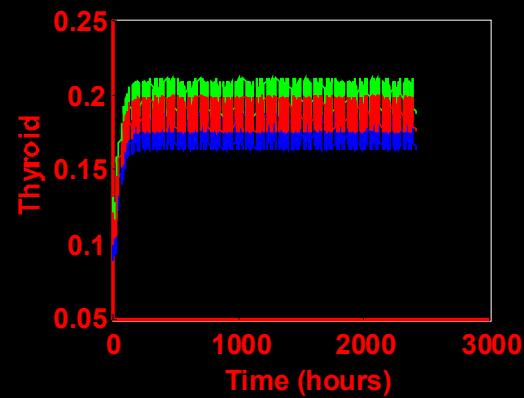
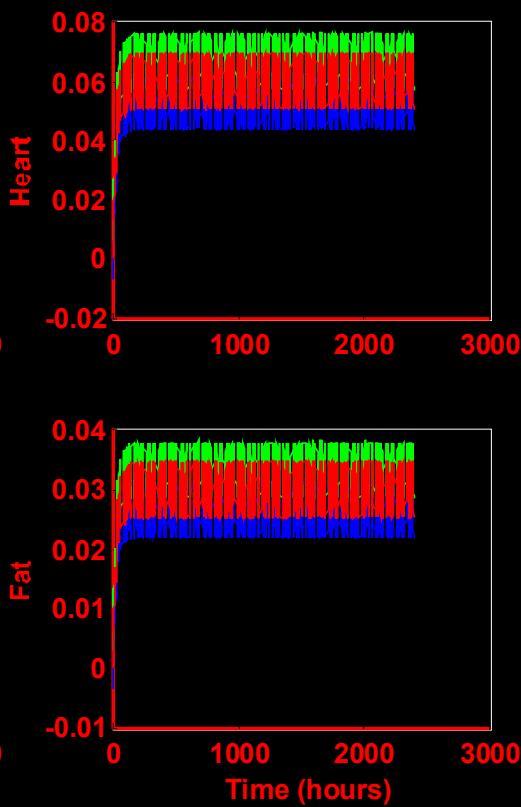
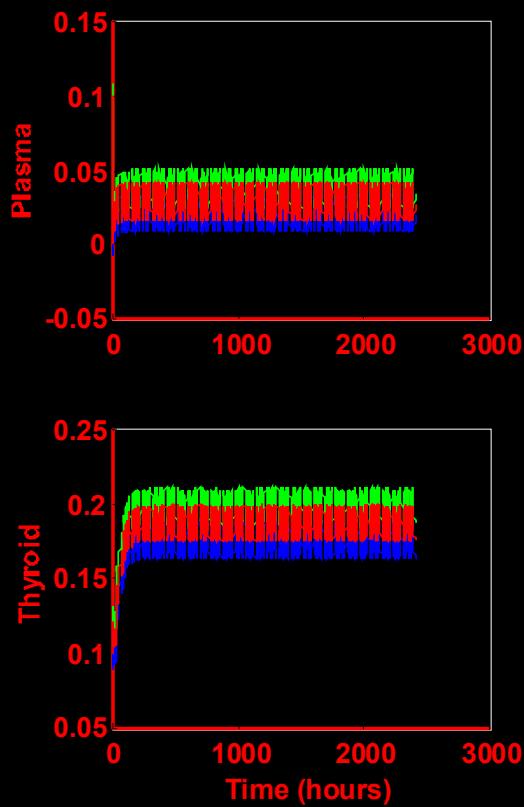
# Relationship Between Perchlorate and T<sub>3</sub> Concentration



# Predicted Perchlorate Concentrations in Gut Content, Gut Wall, Kidney, and Liver, ppb

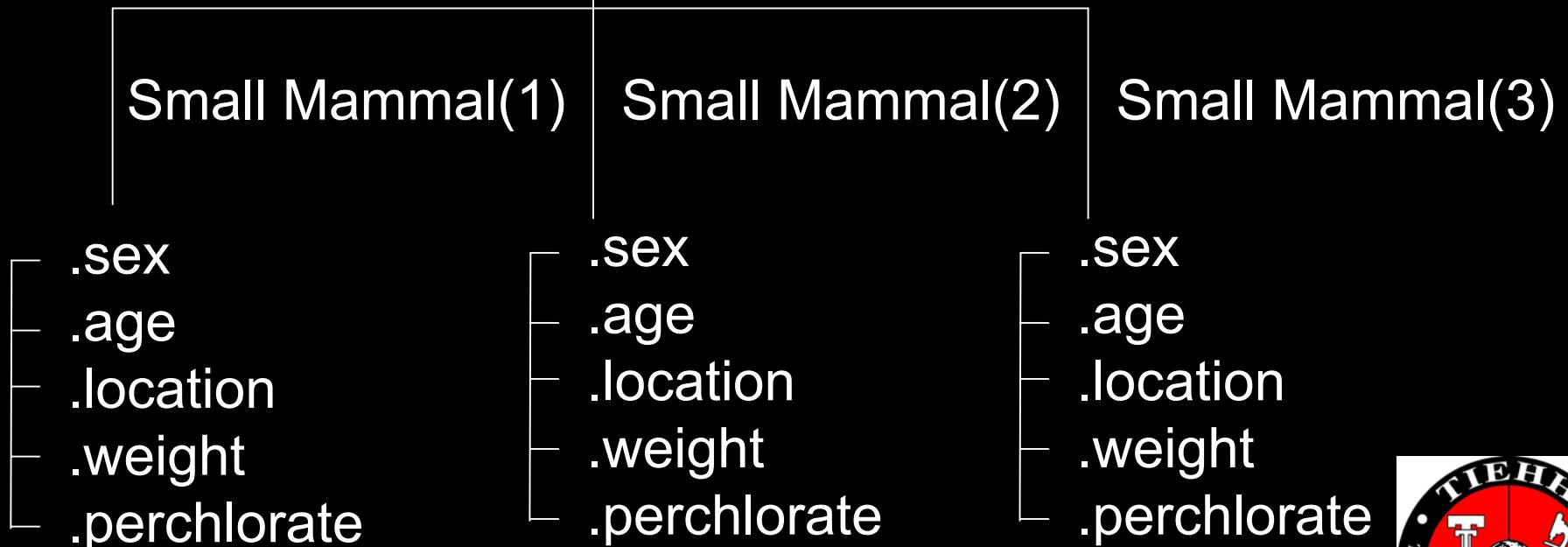


# Predicted Perchlorate Concentrations in Plasma, Heart, Thyroid, and Fat, ppb

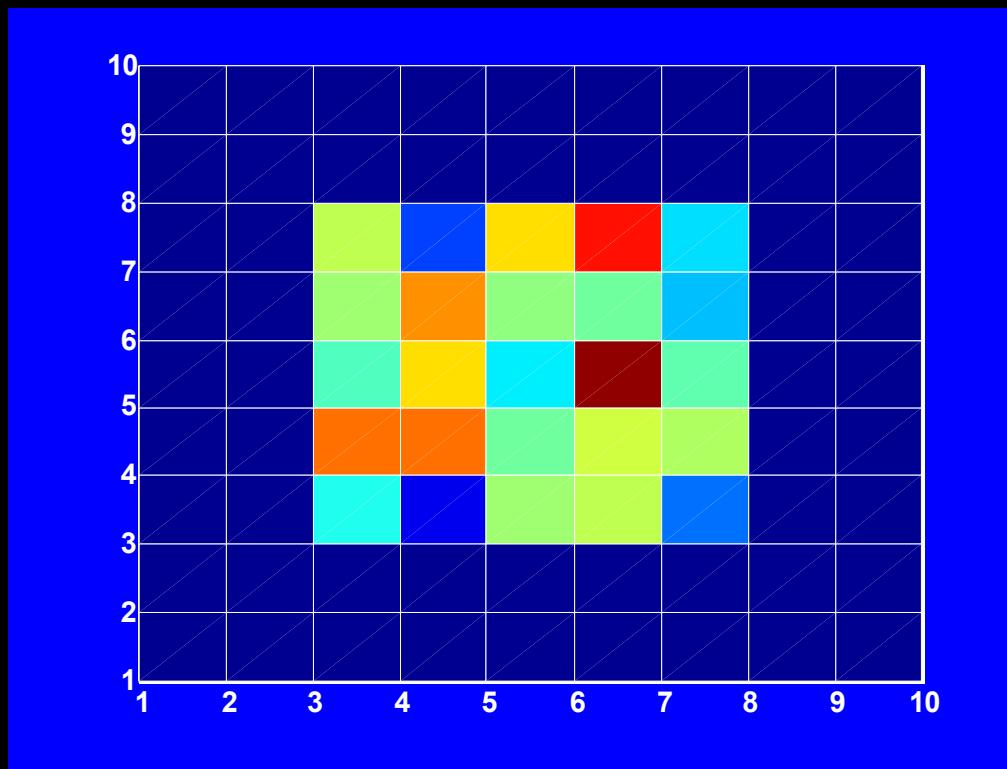


# Multidimensional Structure Array for Small Mammal Movement Model

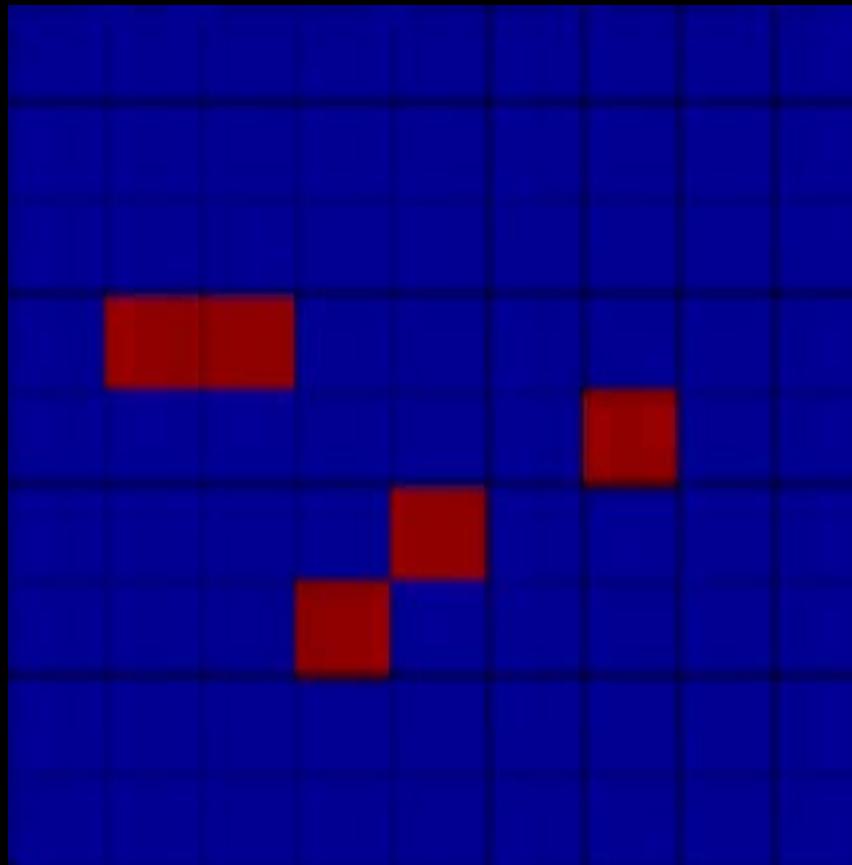
Small  
Mammal  
Array



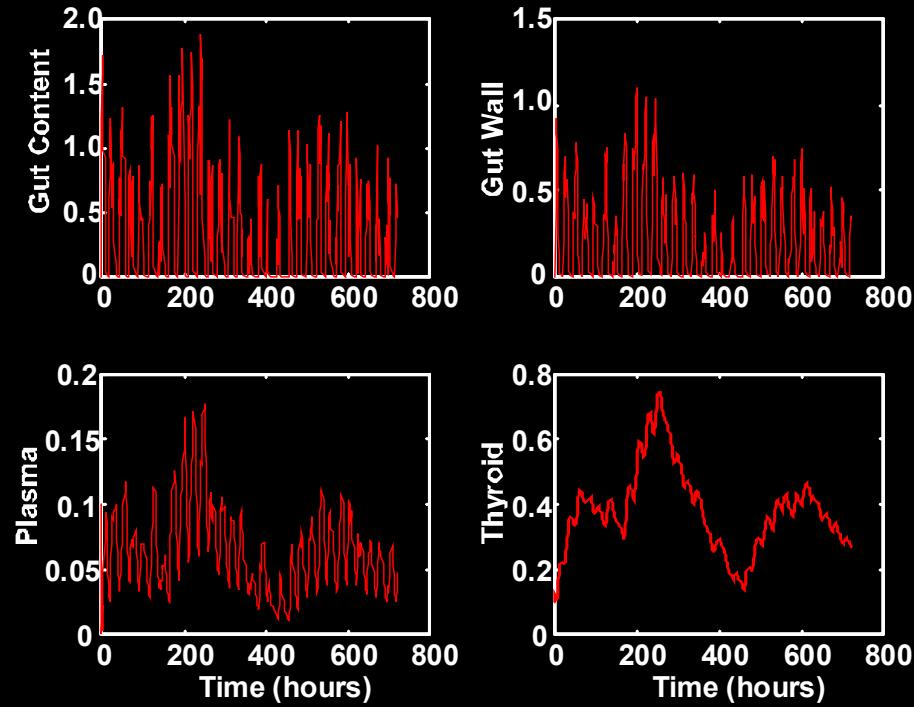
# Spatial Pattern of Perchlorate Concentration in 1000m X 1000m Grid



# Movement of Five Small Mammals Over 12 Hours in 1000m x 1000m Grid



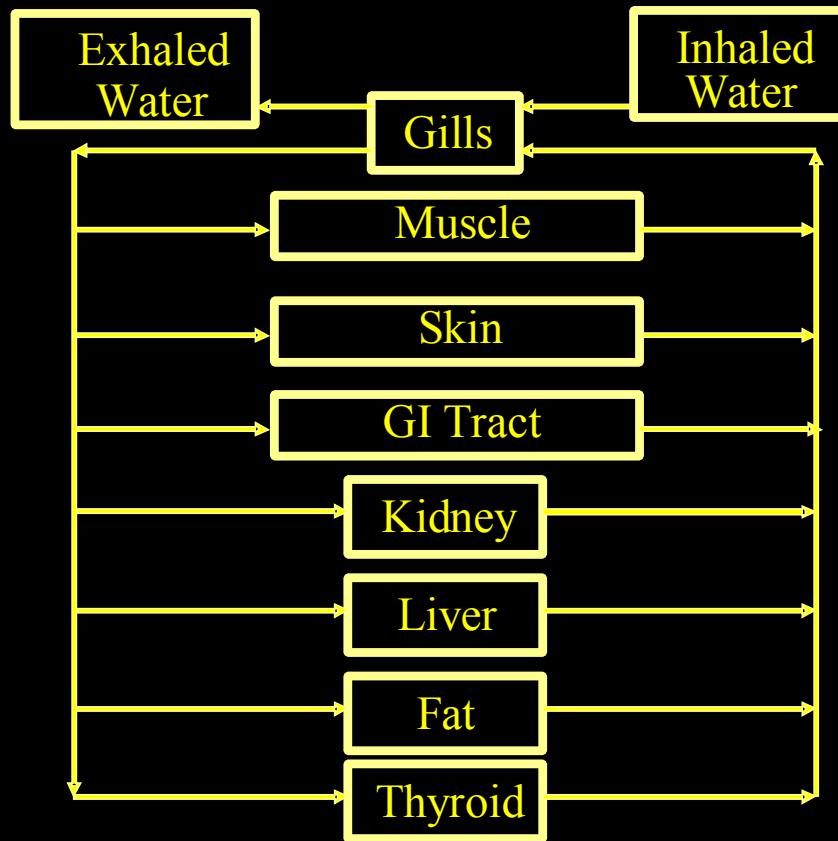
# Mean Perchlorate Concentrations (ppb) in Gut Content, Gut Wall, Blood and Thyroid of Five Small Mammals



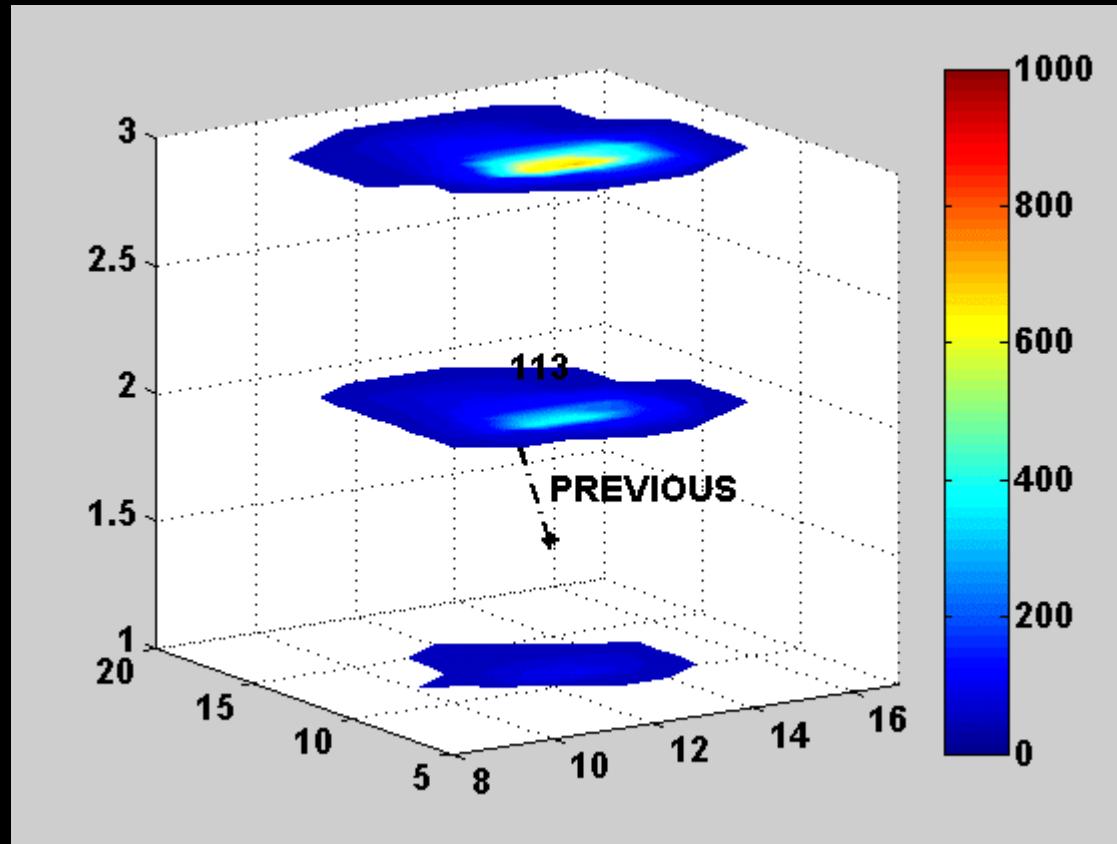
# Fish Model



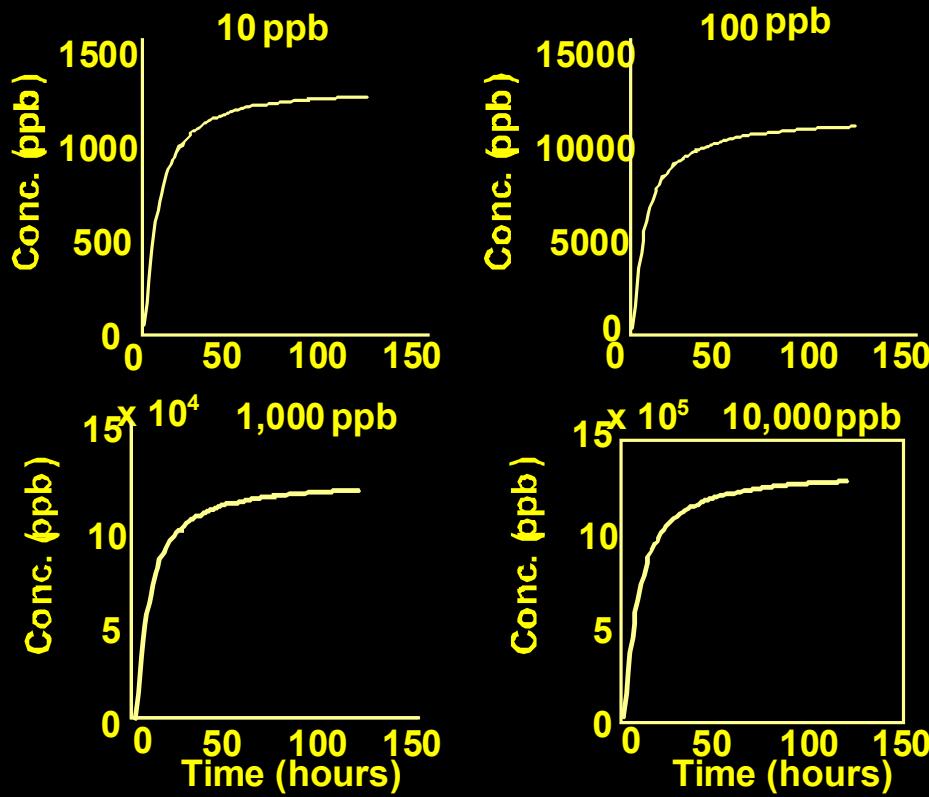
# Flow Diagram



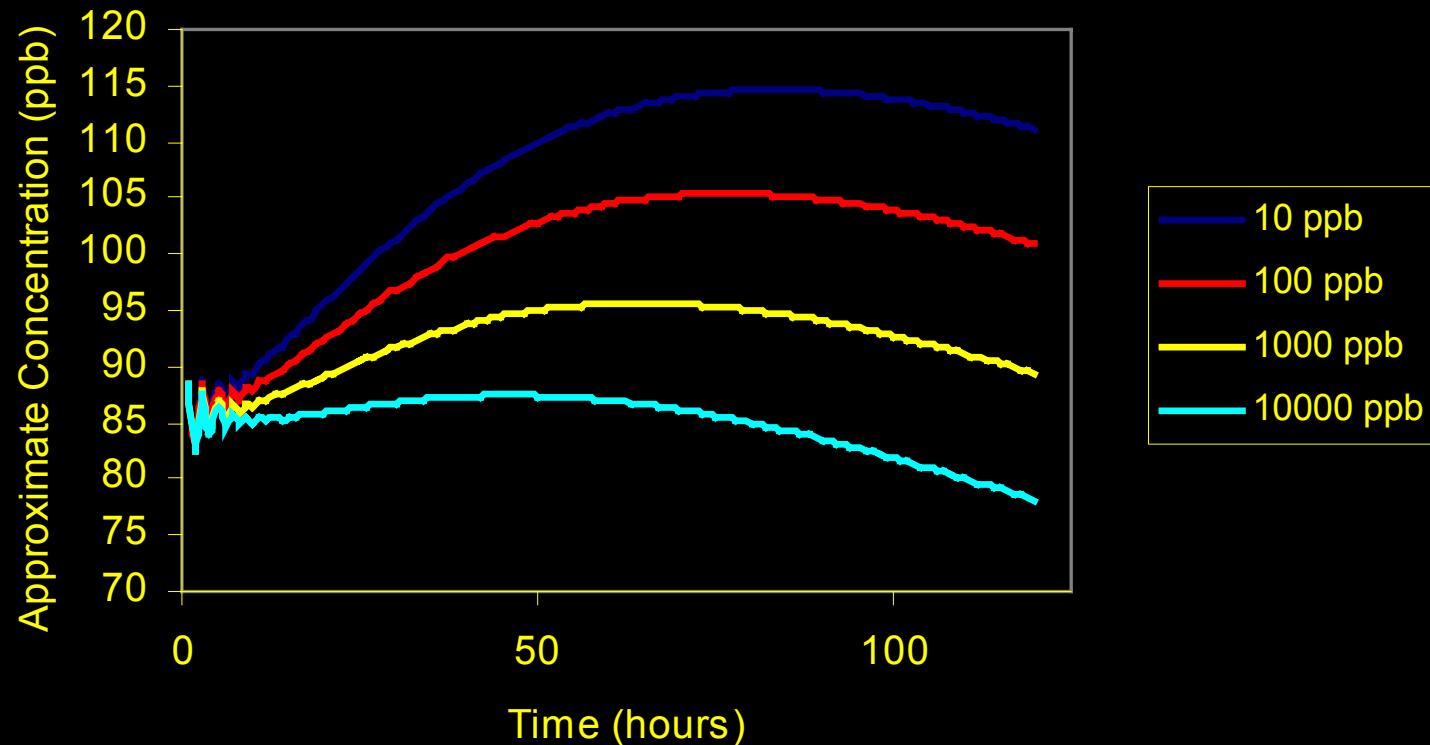
# Fish Movement Model



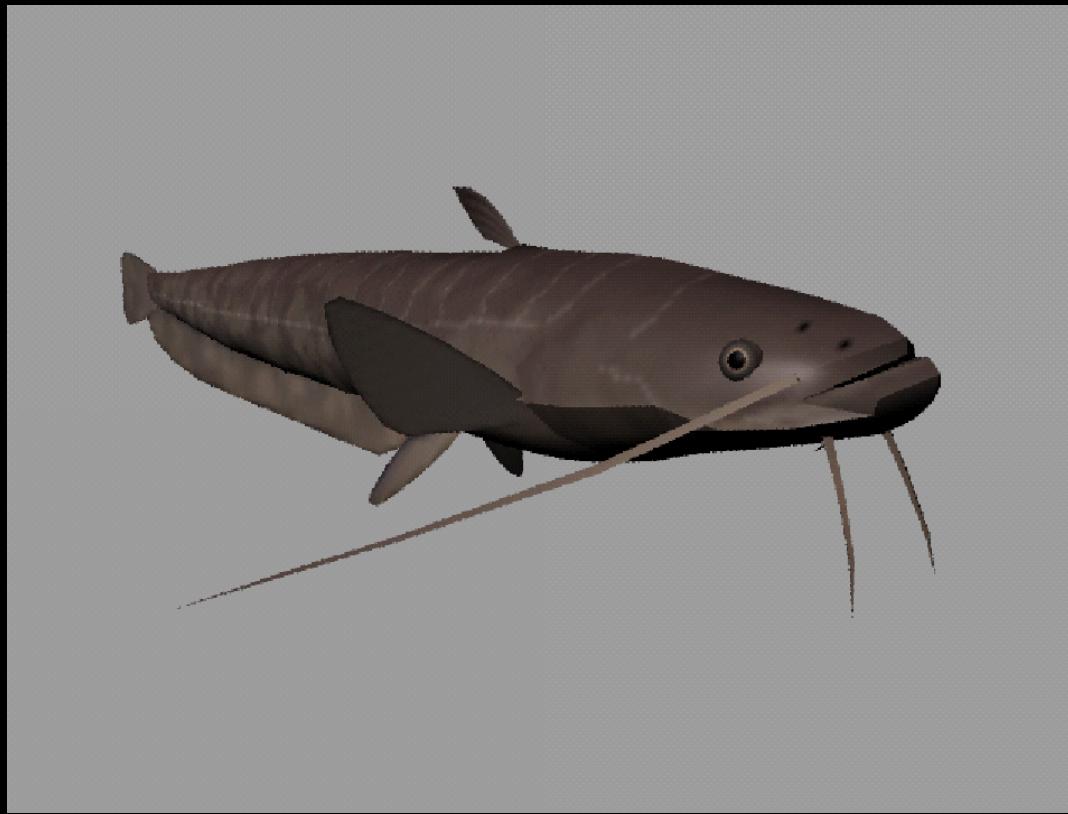
# Thyroid Perchlorate Concentration



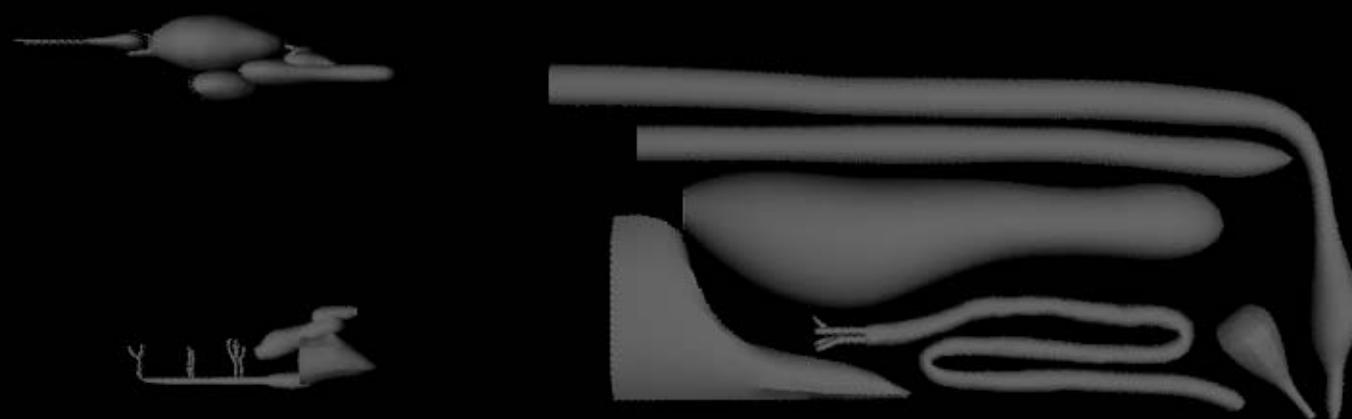
# Predicted T4 (Thyroxine) concentration in Plasma



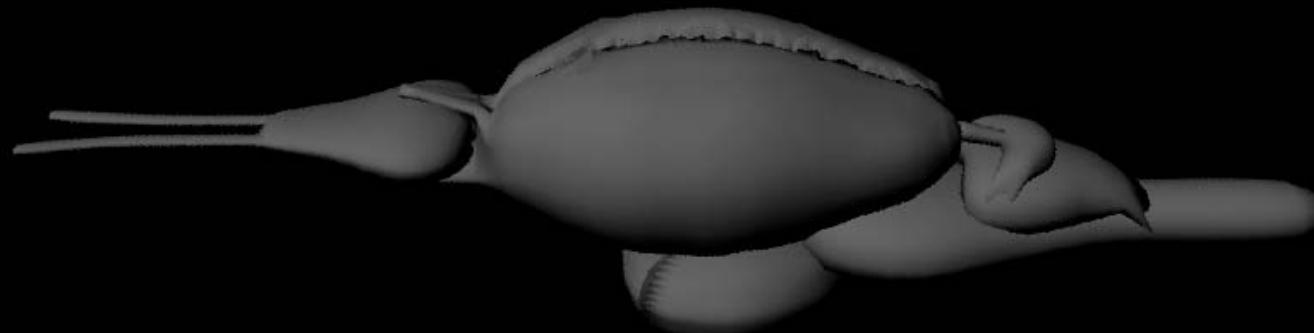
# 3-D Model of Channel Catfish



# 3-D Models of Fish Organs



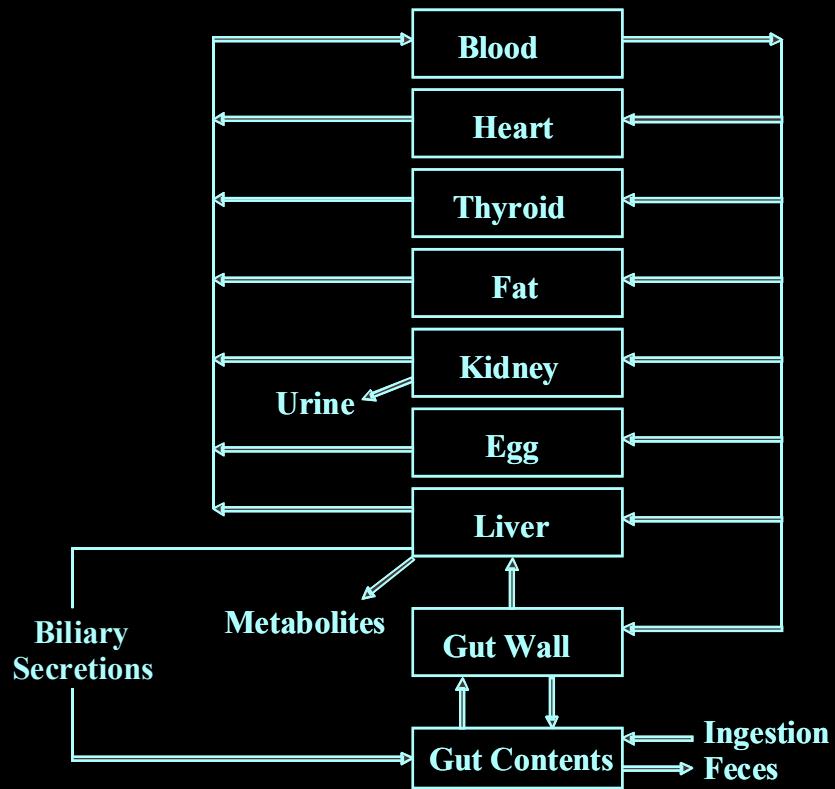
# 3-D Model of Fish Brain



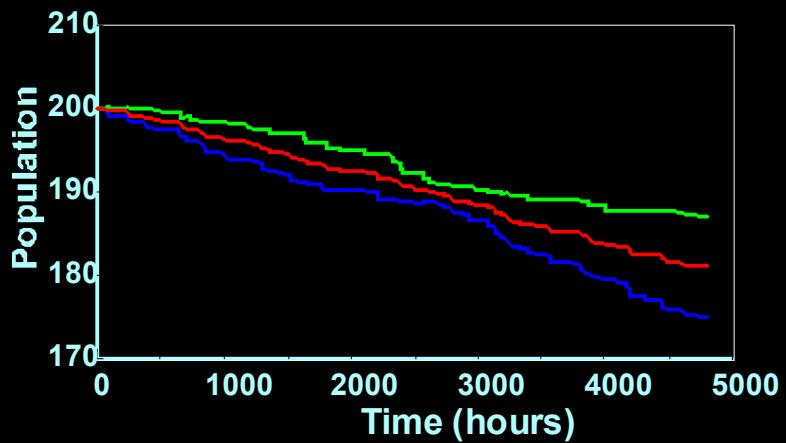
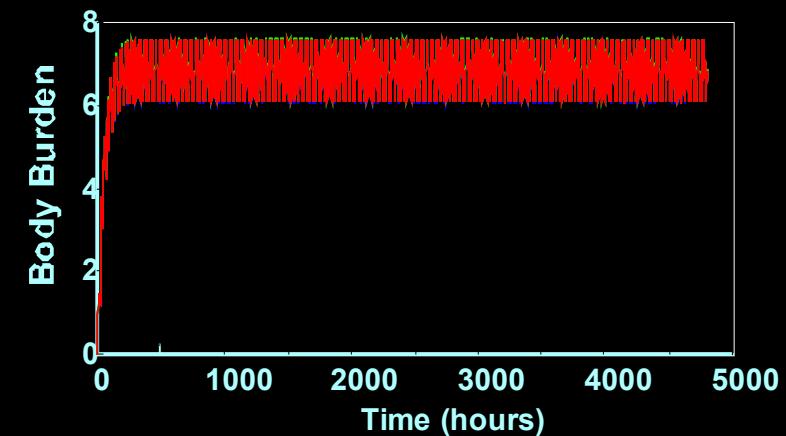
# Avian Model



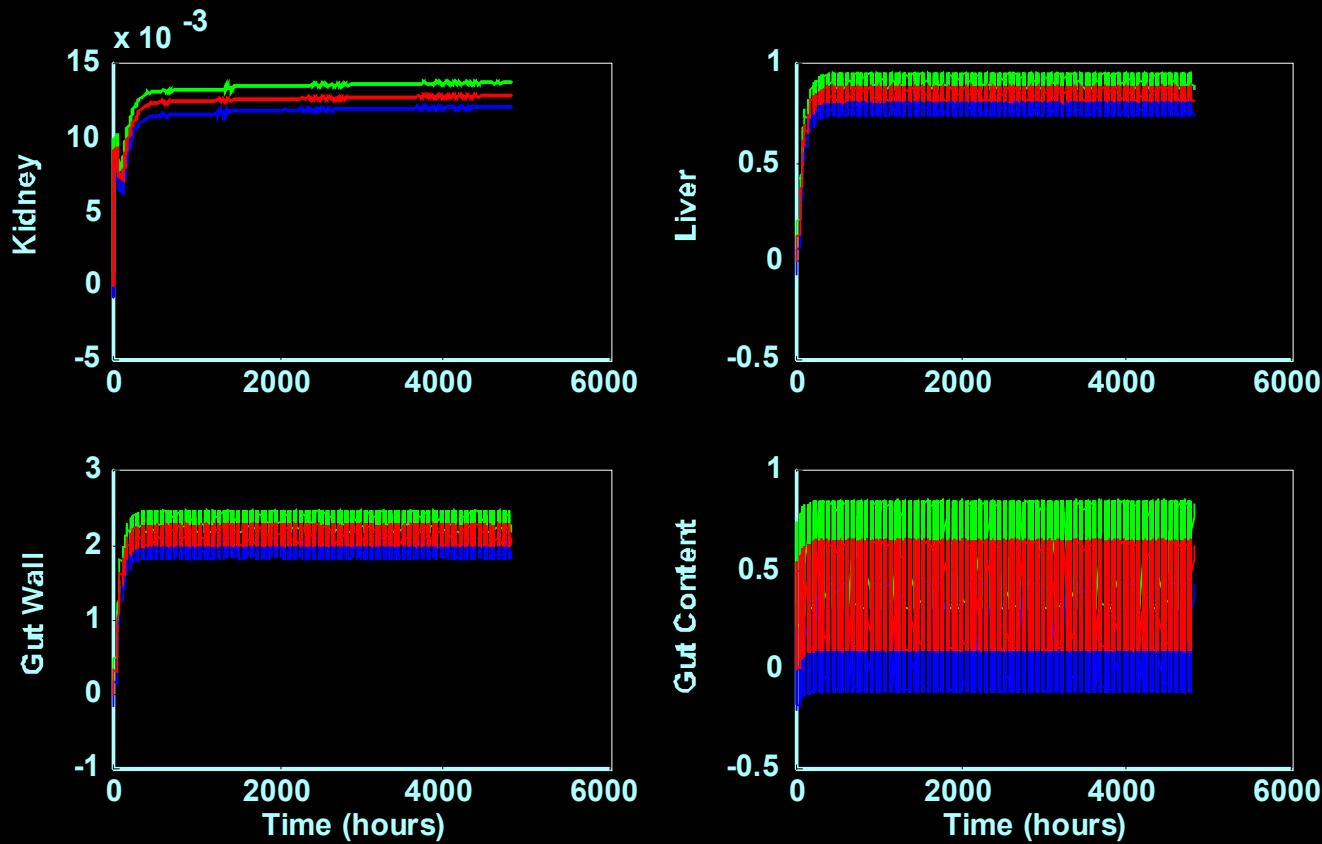
# Flow Diagram



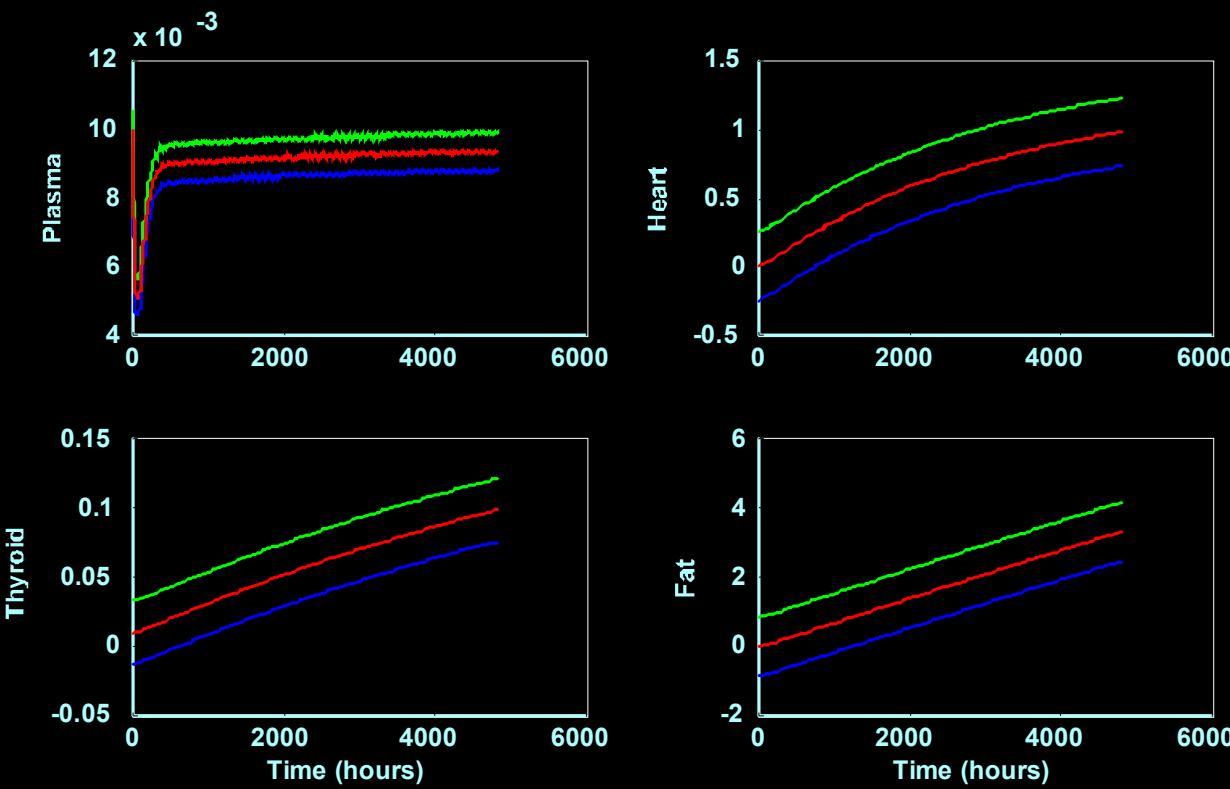
# Avian Body Burden and Population Size



# Predicted Perchlorate Concentrations, ppb



# Predicted Perchlorate Concentrations, ppb



# Egg Perchlorate Concentration

## Mean and 95% CI

